WHAT IS CLAIMED IS:

1. An imaging apparatus comprising:

an imaging optical system;

an image pickup unit which receives an object image passing through said imaging optical system and converts it to image information;

a shake detection unit which detects a shake of said imaging apparatus; and

a shake correction unit which corrects image blurring on said image pickup unit based on the shake detection information detected by said shake detection unit, said imaging apparatus further comprising:

a prediction arithmetic unit which calculates predictive shake information based on the shake detection information, and determines a position as a start position of a correcting operation of said shake correction unit and at which predictive shake is canceled out based on the predictive shake information; and

a control unit which controls driving of said shake correction unit at the correcting-operation start position and corrects the image blurring.

2. The imaging apparatus according to claim 1 further comprising:

a storage unit which updates and stores shake detection

information, together with information for imaging conditions, for a predetermined time interval detected by said shake detection unit, wherein

said prediction arithmetic unit calculates predictive shake information based on the shake detection information and the information for imaging conditions stored in said storage unit, and determines the correcting-operation start position of said shake correction unit based on the predictive shake information.

3. The imaging apparatus according to claim 1 further comprising:

a pre-imaging operation unit which detects a pre-imaging operation of said imaging apparatus to output a signal indicating the pre-imaging operation; and

an imaging starting operation unit which detects an imaging starting operation of said imaging apparatus after the signal indicating the pre-imaging operation is output from said pre-imaging operation unit, and outputs a signal indicating the imaging starting operation, wherein

said control unit controls driving of said shake correction unit to the correcting-operation start position through output of the pre-imaging operation signal, and then controls driving of said shake correction unit through output of the imaging starting operation signal from said imaging

starting operation unit, and corrects the image blurring.

4. The imaging apparatus according to claim 3, wherein said control unit controls driving of said shake correction unit to said correcting-operation start position between the time when the pre-imaging operation signal is output and the time when the imaging starting operation signal is output, and controls driving of said shake correction unit through output of the imaging starting operation signal to correct the image blurring.

5. The imaging apparatus according to claim 3, wherein said prediction arithmetic unit calculates the predictive shake information after the pre-imaging operation signal is output and determines the correcting-operation start position, and stops processing of calculating the predictive shake information and processing of determining the correcting-operation start position after the imaging starting operation signal is output.

6. The imaging apparatus according to claim 1, wherein said control unit imparts the correcting-operation start position as area information having a range.

7. The imaging apparatus according to claim 1, wherein said control unit comprises:

a correlation storage unit which previously stores a correlation between the predictive shake information and the correcting-operation start positions; and

a correcting-operation start position determination unit which determines the correcting-operation start position through retrieval of the correlation stored in said correlation storage unit based on the predictive shake information.

8. The imaging apparatus according to claim 1 further comprising:

a correction range storage unit which previously stores a range in which the driving of said shake correction unit can be controlled;

a detection unit which detects whether a shake quantity of the shake detection information is beyond the range previously stored in said correction range storage unit; and

a warning unit which issues a warning when said detection unit detects the shake quantity that is beyond the range in the middle of controlling the driving of the shake correction unit.

9. The imaging apparatus according to claim 3 further comprising:

a correction range storage unit which previously stores a range in which the driving of said shake correction unit can be controlled;

a prediction unit which computes a predictive shake quantity from the predictive shake information, computes the predictive correction quantity to the predictive shake quantity, and predicts whether the predictive correction quantity is beyond the range previously stored in said correction range storage unit; and

when said prediction unit predicts that the predictive correction quantity will exceed the range,

at least one out of a treating unit which displays a warning; a treating unit which stops the operation of controlling the driving of said shake correction unit to the correcting-operation start position and invalidates the imaging starting operation; and a treating unit which stops the operation of controlling the driving of said shake correction unit to correct the image blurring and validates the imaging starting operation.

10. A shake correction method in an imaging apparatus which comprises: an imaging optical system; an image pickup unit which receives an object image passing through said imaging

optical system and converts it to image information; a shake detection unit which detects a shake of said imaging apparatus; and a shake correction unit which corrects image blurring on said image pickup unit based on the shake detection information detected by said shake detection unit, said shake correction method comprising the steps of:

calculating predictive shake information based on the shake detection information;

determining a position as a start position of correcting operation of said shake correction unit and at which predictive shake will be canceled out based on the predictive shake information; and

correcting the image blurring by controlling driving of said shake correction unit at the correcting-operation start position.

11. The shake correction method in the imaging apparatus according to claim 10 further comprising the steps of:

updating and storing shake detection information, together with information for imaging conditions, for a predetermined time interval detected by said shake detection unit;

calculating predictive shake information based on the stored shake detection information and the information for imaging conditions; and

determining a correcting-operation start position of said shake correction unit based on the predictive shake information.

12. The shake correction method in the imaging apparatus according to claim 10 further comprising the steps of:

detecting a pre-imaging operation of said imaging apparatus;

controlling driving of said shake correction unit to the correcting-operation start position;

detecting an imaging starting operation of said imaging apparatus; and

correcting the image blurring by controlling the driving of said shake correction unit.

13. A shake correction device in an imaging apparatus which has an imaging optical system or an image pickup surface, said shake correction device comprising:

an electromechanical transducer which produces displacement by an electric signal; and

a displacement enlarging mechanism which has two elastic plates fixed to both sides of said mechanism opposite to each other and perpendicular to a displacement direction of said electromechanical transducer and whose opposed surfaces are curved inwardly, and in which a width between

said two elastic plates is enlarged or reduced according to the displacement of said electromechanical transducer, and one of said two elastic plates is fixed to said imaging optical system or said image pickup surface, wherein

the displacement due to said electromechanical transducer is enlarged by said displacement enlarging mechanism, the enlargement moves said imaging optical system or said image pickup surface to move an incident position of an incident light to said image pickup surface, and shake is corrected.

14. The shake correction device in the imaging apparatus according to claim 13, further comprising:

a biasing unit which provides a biasing force in a reverse direction to the enlargement due to said displacement enlarging mechanism, to said imaging optical system, said image pickup surface, or said variable apex angle prism.

15. The shake correction device in the imaging apparatus according to claim 14, wherein

said biasing unit is a pressing unit which is disposed fixedly as a unit separately from said imaging optical system or said image pickup surface, and presses said imaging optical system or said image pickup surface in a specific direction.

16. The shake correction device in the imaging apparatus according to claim 14, wherein

said biasing unit has a biasing force such that a difference, between a biasing force when the displacement of said electromechanical transducer with respect to said imaging optical system or said image pickup surface is zero and a biasing force when the displacement of said electromechanical transducer thereto is the maximum, is a predetermined value or less.

17. The shake correction device in the imaging apparatus according to claim 13, wherein

a substantially cylindrical member is disposed between one of said two elastic plates of said displacement enlarging mechanism and said imaging optical system or said image pickup surface.

18. A shake correction device in an imaging apparatus which has a variable apex angle prism, said shake correction device comprising:

an electromechanical transducer which produces displacement by an electric signal; and

a displacement enlarging mechanism which has two elastic plates fixed to both sides of said mechanism opposite to each other and perpendicular to a displacement direction

of said electromechanical transducer and whose opposed surfaces are curved inwardly, and in which a width between said two elastic plates is enlarged or reduced according to the displacement of said electromechanical transducer, and one of said two elastic plates is fixed to said variable apex angle prism, wherein

the displacement due to said electromechanical transducer is enlarged by said displacement enlarging mechanism, said enlargement varies the apex angle of said variable apex angle prism to move an incident position of an incident light to said image pickup surface, and shake is corrected.

19. The shake correction device in the imaging apparatus according to claim 18, further comprising:

a biasing unit which provides a biasing force in a reverse direction to the enlargement due to said displacement enlarging mechanism, to said imaging optical system, said image pickup surface, or said variable apex angle prism.

20. The shake correction device in the imaging apparatus according to claim 19, wherein

said biasing unit is a pressing unit which is disposed fixedly as a unit separately from said imaging optical system or said image pickup surface, and presses said imaging

optical system or said image pickup surface in a specific direction.

21. The shake correction device in the imaging apparatus according to claim 19, wherein

said biasing unit has a biasing force such that a difference, between a biasing force when the displacement of said electromechanical transducer with respect to said imaging optical system or said image pickup surface is zero and a biasing force when the displacement of said electromechanical transducer thereto is the maximum, is a predetermined value or less.

22. A shake correction device in an imaging apparatus which comprises an imaging optical system; and an image pickup unit that receives an object image passing through said imaging optical system and converts it to image information, said shake correction device comprising:

a shake-correction use supporting unit which supports said image pickup unit so as to be capable of vibrating in a direction perpendicular to an optical axis of said imaging optical system;

a shake-correction use driving unit which vibrates said image pickup unit in a direction perpendicular to the optical axis in order to cancel out the shake of said imaging

apparatus;

a pixel-shifting use supporting unit which supports said image pickup unit, said shake-correction use supporting unit, and said shake-correction use driving unit movably in the pixel shifting direction perpendicular to the optical axis; and

a pixel-shifting use driving unit which moves said image pickup unit, said shake-correction use supporting unit, and said shake-correction use driving unit in the pixel shifting direction by a specified quantity.

23. The shake correction device in the imaging apparatus according to claim 22, wherein

said shake-correction use driving unit and said pixel-shifting use driving unit are formed with multilayer piezoelectric elements that displace through application of a voltage.

24. The shake correction device in the imaging apparatus according to claim 23, wherein

said multilayer piezoelectric elements for said shake-correction use driving unit and said pixel-shifting use driving unit are disposed in positions on the substantially same plane opposite to said imaging optical system of said image pickup unit.

25. The shake correction device in the imaging apparatus according to claim 22, wherein said pixel-shifting use supporting unit comprises:

guide pins which are fixed to said shake-correction use supporting unit and are extendedly provided on the opposite side to said imaging optical system in the direction of the optical axis;

a fixed base guided by said guide pins movably in the pixel shifting direction; and

a lead-in spring which brings said fixed base and said shake-correction use supporting unit into contact with each other in the direction of the optical axis.

26. The shake correction device in the imaging apparatus according to claim 25, wherein

said pixel-shifting use driving unit is formed with a multilayer piezoelectric element that displaces through application of a voltage;

said multilayer piezoelectric element and said shake-correction use driving unit are disposed in positions on the substantially same plane of said fixed base opposite to said imaging optical system so that the displacement direction coincides with the pixel shifting direction;

one end of said multilayer piezoelectric element is fixed to said shake-correction use supporting unit and the

other end of said multilayer piezoelectric element is fixed to said fixed base; and

return springs are disposed between said shake-correction use supporting unit and said fixed base.

27. The shake correction device in the imaging apparatus according to claim 22, wherein

a connection part at one end of a wiring member is connected to said image pickup unit, a connection terminal connecting to another electric circuit is provided at the other end of said wiring member, and a flexible wiring part is wired between said connection part and said connection terminal, and

said flexible wiring part is a band-like flexible insulator on which a plurality of wiring patterns are printed in parallel with each other and a plurality of slits are provided each between said wiring patterns and in parallel with the wiring patterns.

28. A shake correction device in an imaging apparatus which comprises an imaging optical system; and an image pickup unit that receives an object image passing through said imaging optical system and converts it to image information, said shake correction device comprising:

shake-correction use supporting units which support

said image pickup unit so as to be capable of vibrating in the X direction and the Y direction perpendicular to the optical axis of said imaging optical system and orthogonal to each other; and

shake-correction use driving units which vibrate said image pickup unit in the X and Y directions in order to cancel out the shake of said imaging apparatus,

wherein said shake-correction use supporting unit comprises a first flat spring body that displaces substantially in the Y direction; a second flat spring body that displaces substantially in the X direction; a first support plate to which one end of said first flat spring body is fixed and which is perpendicular to the optical axis; a second support plate to which one end of said second flat spring body is fixed and which is perpendicular to the optical axis; and a third support plate to which the other ends of said first flat spring body and said second flat spring body are fixed and which is perpendicular to the optical axis,

said image pickup unit is disposed between said first support plate, said second support plate, and said third support plate, and is supported by either said first support plate or said second support plate, and

said shake-correction use driving units are disposed between said first support plate and said second support plate.

29. The shake correction device in the imaging apparatus according to claim 28, wherein

said first flat spring body is parallel to the optical axis in its longitudinal direction, is formed with four flat springs disposed symmetrically with respect to the optical axis, and forms a link with said first support plate and said third support plate, and

said second flat spring body is parallel to the optical axis in its longitudinal direction, is formed with four flat springs disposed symmetrically with respect to the optical axis, and forms a link with said second support plate and said third support plate.

30. The shake correction device in the imaging apparatus according to claim 29, wherein

each of said first flat spring body and said second flat spring body is composed of two flat spring units, and

each of said flat spring units has a structure with an opening at the center of a sheet of spring plate to form two flat springs.

31. The shake correction device in the imaging apparatus according to claim 29, wherein

both ends of each of said first flat spring body and said second flat spring body are folded into the side of

the optical axis, and said folded ends work as positioning and fixing parts for fixing said bodies to said first support plate, said second support plate, and said third support plate.

32. The shake correction device in the imaging apparatus according to claim 28, wherein

a connection part at one end of a wiring member is connected to said image pickup unit, a connection terminal connecting to another electric circuit is provided at the other end of said wiring member, and a flexible wiring part is wired between said connection part and said connection terminal, and

said flexible wiring part is a band-like flexible insulator on which a plurality of wiring patterns are printed in parallel with each other and a plurality of slits are provided each between said wiring patterns and in parallel with the wiring patterns.

33. A shake correction device in an imaging apparatus which comprises an imaging optical system; and an image pickup unit that receives an object image passing through said imaging optical system and converts it to image information, said shake correction device comprising:

shake-correction use supporting units which support

said image pickup unit so as to be capable of vibrating in the X direction and the Y direction perpendicular to the optical axis of said imaging optical system, and orthogonal to each other; and

shake-correction use driving units which vibrate said image pickup unit in the X and Y directions in order to cancel out the shake of said imaging apparatus,

wherein said shake-correction use supporting unit comprises a movable-side support part that supports said image pickup unit; and a fixed-side support part that supports said movable-side support part so as to be capable of vibrating said movable-side support part in the X and Y directions,

said shake-correction use driving unit is formed with a multilayer piezoelectric element with an enlarging mechanism having a displacement part that enlarges in a direction perpendicular to the displacement direction of said multilayer piezoelectric element that displaces through application of a voltage,

said multilayer piezoelectric element with an enlarging mechanism has a multilayer piezoelectric element with the X-direction enlarging mechanism disposed so that the displacement direction of said displacement part coincides with the X direction; and a multilayer piezoelectric element with a Y-direction enlarging

mechanism disposed so that the displacement direction of said displacement part coincides with the Y direction, and

said displacement part of said multilayer piezoelectric element with the X-direction enlarging mechanism and said displacement part of said multilayer piezoelectric element with the Y-direction enlarging mechanism are disposed between said movable-side support part and said fixed-side support part, respectively.

34. The shake correction device in the imaging apparatus according to claim 33, wherein

said multilayer piezoelectric element with the X-direction enlarging mechanism and said multilayer piezoelectric element with the Y-direction enlarging mechanism are disposed in positions on the substantially same plane opposite to said imaging optical system of said image pickup unit.

35. The shake correction device in the imaging apparatus according to claim 34, said shake correction device further comprising:

an X-direction biasing spring which is disposed between said movable-side support part and said fixed-side support part, and brings said movable-side support part and said fixed-side support part into contact with the

displacement part of said multilayer piezoelectric element with the X-direction enlarging mechanism in the X direction; and

a Y-direction biasing spring which is disposed between said movable-side support part and said fixed-side support part, and brings said movable-side support part and said fixed-side support part into contact with the displacement part of said multilayer piezoelectric element with the Y-direction enlarging mechanism in the Y direction,

wherein said X-direction biasing spring and said Y-direction biasing spring are formed with a single biasing spring.

36. The shake correction device in the imaging apparatus according to claim 35, wherein

X-direction rollers, which rotate in the Y direction, are disposed between the displacement part of said multilayer piezoelectric element with the X-direction enlarging mechanism and said X-direction biasing spring and either one of said movable-side support part and said fixed-side support part; and

Y-direction rollers, which rotate in the X direction, are disposed between the displacement part of said multilayer piezoelectric element with the Y-direction enlarging mechanism and said Y-direction biasing spring and either

one of said movable-side support part and said fixed-side support part.

37. The shake correction device in the imaging apparatus according to claim 36, wherein

an X-direction adjustment screw, which adjusts an initial position in the X direction, is provided between the displacement part of said multilayer piezoelectric element with the X-direction enlarging mechanism and the other one of said movable-side support part and said fixed-side support part; and

a Y-direction adjustment screw, which adjusts an initial position in the Y direction, is provided between the displacement part of said multilayer piezoelectric element with the Y-direction enlarging mechanism and the other one of said movable-side support part and said fixed-side support part.

38. The shake correction device in the imaging apparatus according to claim 33, wherein

a connection part at one end of a wiring member is connected to said image pickup unit, a connection terminal connecting to another electric circuit is provided at the other end of said wiring member, and a flexible wiring part is wired between said connection part and said connection

terminal, and

said flexible wiring part is a band-like flexible insulator on which a plurality of wiring patterns are printed in parallel with each other and a plurality of slits are provided each between said wiring patterns and in parallel with the wiring patterns.

39. An imaging apparatus comprising:

said shake correction device in the imaging apparatus which a shake correction device in an imaging apparatus which comprises an imaging optical system; and an image pickup unit that receives an object image passing through said imaging optical system and converts it to image information, said shake correction device comprising:

a shake-correction use supporting unit which supports said image pickup unit so as to be capable of vibrating in a direction perpendicular to an optical axis of said imaging optical system;

a shake-correction use driving unit which vibrates said image pickup unit in a direction perpendicular to the optical axis in order to cancel out the shake of said imaging apparatus;

a pixel-shifting use supporting unit which supports said image pickup unit, said shake-correction use supporting unit, and said shake-correction use driving unit movably

in the pixel shifting direction perpendicular to the optical axis; and

a pixel-shifting use driving unit which moves said image pickup unit, said shake-correction use supporting unit, and said shake-correction use driving unit in the pixel shifting direction by a specified quantity;

a shake correction control unit which controls driving of said shake-correction use driving unit; and

a pixel shifting control unit which controls driving of said pixel-shifting use driving unit.

40. The imaging apparatus according to claim 39,

wherein a connection part at one end of a wiring member is connected to said image pickup unit, a connection terminal connecting to another electric circuit is provided at the other end of said wiring member, and a flexible wiring part is wired between said connection part and said connection terminal, and

said flexible wiring part is a band-like flexible insulator on which a plurality of wiring patterns are printed in parallel with each other and a plurality of slits are provided between said wiring patterns and in parallel with the wiring patterns.

41. A imaging apparatus comprising:

said shake correction device in the imaging apparatus which a shake correction device in a imaging apparatus which comprises a imaging optical system; and an image pickup unit that receives an object image passing through said imaging optical system and converts it to image information, said shake correction device comprising:

shake-correction use supporting units which support said image pickup unit so as to be capable of vibrating in the X direction and the Y direction perpendicular to the optical axis of said imaging optical system and orthogonal to each other; and

shake-correction use driving units which vibrate said image pickup unit in the X and Y directions in order to cancel out the shake of said imaging apparatus,

wherein said shake-correction use supporting unit comprises a first flat spring body that displaces substantially in the Y direction; a second flat spring body that displaces substantially in the X direction; a first support plate to which one end of said first flat spring body is fixed and which is perpendicular to the optical axis; a second support plate to which one end of said second flat spring body is fixed and which is perpendicular to the optical axis; and a third support plate to which the other ends of said first flat spring body and said second flat spring body

are fixed and which is perpendicular to the optical axis,

said image pickup unit is disposed between said first support plate, said second support plate, and said third support plate, and is supported by either said first support plate or said second support plate, and

said shake-correction use driving units are disposed between said first support plate and said second support plate; and

a shake correction control unit which controls driving of said shake-correction use driving unit.

42. The imaging apparatus according to claim 41,

wherein a connection part at one end of a wiring member is connected to said image pickup unit, a connection terminal connecting to another electric circuit is provided at the other end of said wiring member, and a flexible wiring part is wired between said connection part and said connection terminal, and

said flexible wiring part is a band-like flexible insulator on which a plurality of wiring patterns are printed in parallel with each other and a plurality of slits are provided between said wiring patterns and in parallel with the wiring patterns.

43. A imaging apparatus comprising:

said shake correction device in the imaging apparatus which a shake correction device in a imaging apparatus which comprises a imaging optical system; and an image pickup unit that receives an object image passing through said imaging optical system and converts it to image information, said shake correction device comprising:

shake-correction use supporting units which support said image pickup unit so as to be capable of vibrating in the X direction and the Y direction perpendicular to the optical axis of said imaging optical system, and orthogonal to each other; and

shake-correction use driving units which vibrate said image pickup unit in the X and Y directions in order to cancel out the shake of said imaging apparatus,

wherein said shake-correction use supporting unit comprises a movable-side support part that supports said image pickup unit; and a fixed-side support part that supports said movable-side support part so as to be capable of vibrating said movable-side support part in the X and Y directions,

said shake-correction use driving unit is formed with a multilayer piezoelectric element with an enlarging mechanism having a displacement part that enlarges in a direction perpendicular to the displacement direction of

said multilayer piezoelectric element that displaces through application of a voltage,

said multilayer piezoelectric element with an enlarging mechanism has a multilayer piezoelectric element with the X-direction enlarging mechanism disposed so that the displacement direction of said displacement part coincides with the X direction; and a multilayer piezoelectric element with a Y-direction enlarging mechanism disposed so that the displacement direction of said displacement part coincides with the Y direction, and

said displacement part of said multilayer piezoelectric element with the X-direction enlarging mechanism and said displacement part of said multilayer piezoelectric element with the Y-direction enlarging mechanism are disposed between said movable-side support part and said fixed-side support part, respectively; and

a shake correction control unit which controls driving of said shake-correction use driving unit.

44. The imaging apparatus according to claim 43,

wherein a connection part at one end of a wiring member is connected to said image pickup unit, a connection terminal connecting to another electric circuit is provided at the other end of said wiring member, and a flexible wiring part is wired between said connection part and said connection

terminal, and

said flexible wiring part is a band-like flexible insulator on which a plurality of wiring patterns are printed in parallel with each other and a plurality of slits are provided between said wiring patterns and in parallel with the wiring patterns.